Section 4

Air Quality

Reading Preview

Key Concepts

- What are the major sources of air pollution?
- What causes smog and acid rain?
- What can be done to improve air quality?

Key Terms

- pollutants
- photochemical smog
- acid rain

Target Reading Skill

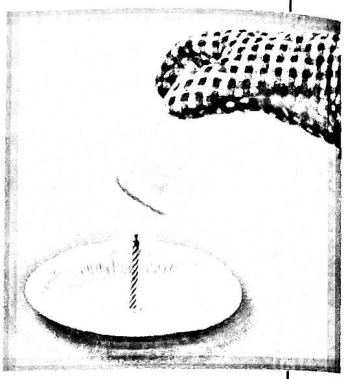
Outlining As you read, make an outline about air quality that you can use for review. Use the red headings for the main topics and the blue headings for the subtopics.

Air Quality
I. Sources of air pollution
A. Natural sources
B.
C.
II. Smog and acid rain
A.

Lab zone **Discover Activity**

What's on the Jar?

1. Put on your goggles.
2. Put a small piece of modeling clay on a piece of aluminum foil. Push a candle into the clay. Light the candle.
3. Wearing an oven mitt, hold a glass jar by the rim so that the bottom of the jar is just above the flame.



Think It Over

Observing What do you see on the jar? Where did it come from?

As you are reading this page, you are breathing without even thinking about it. Breathing brings air into your lungs, where the oxygen you need is taken into your body. But not everything in the air is healthful. You may also breathe in tiny particles or even a small amount of harmful gases.

If you live in a large city, you may have noticed a brown haze in the air. Even if you live far from a city, the air around you may contain pollutants. **Pollutants** are harmful substances in the air, water, or soil. Air that contains harmful particles and gases is said to be polluted.

Air pollution can affect the health of humans and other living things. Figure 12 identifies the effects of some pollutants.

FIGURE 11
Air Pollution
Air pollution in large cities, such as Mexico City, can cause serious health problems.

Effects of Air Pollution on Human Health

Pollutant	Source	Health Effect
Carbon monoxide	Burning of fossil fuels	Reduced ability of blood to deliver oxygen to cells
Nitrogen dioxide	Burning of fossil fuels	Breathing problems, lung damage
Ozone	Chemical reaction of certain carbon compounds	Breathing problems, asthma, eye irritation
Particles of dust, smoke, or soot	Burning of wood and fossil fuels, volcanic eruptions	Respiratory illnesses, nose and throat irritation
Sulfur dioxide	Burning of fossil fuels, volcanic eruptions	Breathing problems, lung damage

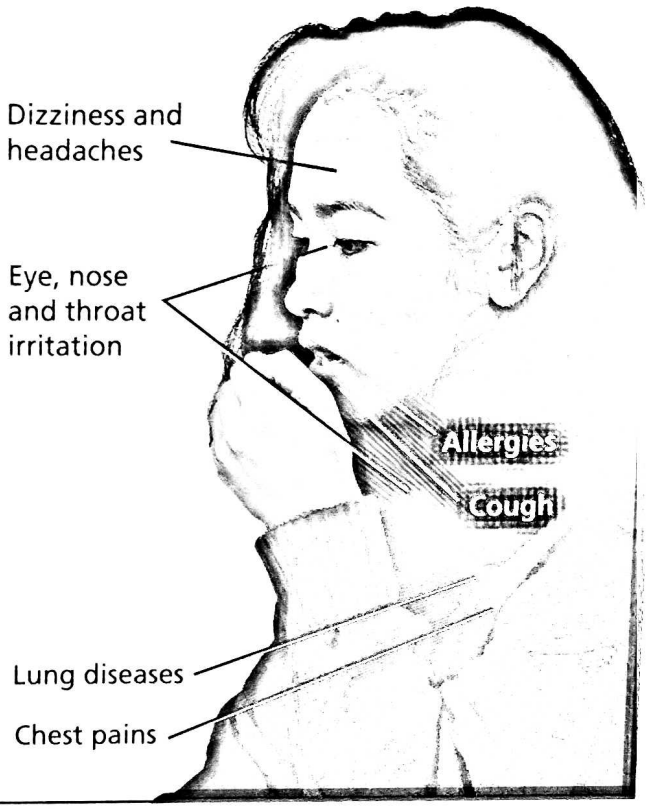


FIGURE 12
Air pollution can cause many different problems. The table shows the health effects of air pollution. Pollen also can cause difficulties for people with allergies.

Sources of Pollution

Some air pollution occurs naturally. But many types of air pollution are the result of human activities.

Natural Sources Many natural processes add particles to the atmosphere. Forest fires, soil erosion, and dust storms release a great deal of smoke and dust into the air. The wind carries particles of molds and pollen. Erupting volcanoes spew out clouds of dust and ash along with poisonous gases.

Human Activities Human activities, such as farming and construction, can send soil and dust into the air. But most air pollution is the result of burning fossil fuels, such as coal, oil, gasoline, and diesel fuel. Almost half of this pollution comes from cars and other motor vehicles. Factories and power plants that burn coal and oil also release pollution.

When fossil fuels burn, they release both particles and gases. When people burn wood or coal, particles of soot enter the air. Soot gives smoke its dark color. All fossil fuels contain hydrocarbons, compounds made of hydrogen and carbon. As fossil fuels burn, some hydrocarbons do not burn completely and escape into the air. Burning fossil fuels produces a variety of pollutants, including carbon monoxide, nitrogen oxides, and sulfur oxides.

Reading Checkpoint **What are some air pollutants produced by burning fossil fuels?**

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Smog and Acid Rain

High levels of air pollution decrease the quality of the air. The burning of fossil fuels can cause smog and acid rain.

London-Type Smog One hundred years ago, the city of London, England, was dark and dirty. Factories burned coal, and most houses were heated by coal. The air was full of soot. In 1905, the term *smog* was created by combining the words *smoke* and *fog* to describe this type of air pollution. Typically, London-type smog forms when particles in coal smoke combine with water droplets in humid air. Today, people in London burn much less coal. As a result, the air in London now is much cleaner than it was 100 years ago.

Photochemical Smog Fortunately, London-type smog is no longer common in the United States. Instead, many cities today have another type of smog. The brown haze that develops in sunny cities is called **photochemical smog** (foh toh KEM ih kul). The *photo-* in photochemical means "light." Photochemical smog is formed by the action of sunlight on pollutants such as hydrocarbons and nitrogen oxides. These chemicals react to form a brownish mixture of ozone and other pollutants.

Recall that ozone in the stratosphere blocks ultraviolet radiation, thus protecting living things on Earth. But in the troposphere, ozone is a pollutant that can irritate the eyes, throat, and lungs. It can also harm plants and other living things and damage many materials.

FIGURE 13
Results of Acid Rain
This scientist is studying trees damaged by acid rain. Needle-leafed trees such as pines and spruce are especially sensitive to acid rain. Acid rain may make tree needles turn brown or fall off.

Acid Rain Another result of air pollution is acid rain. Rain is naturally slightly acidic, but rain that contains more acid than normal is known as **acid rain.**

How does acid rain form? The burning of coal that contains a lot of sulfur produces sulfur oxides, substances composed of oxygen and sulfur. Acid rain forms when nitrogen oxides and sulfur oxides combine with water in the air to form nitric acid and sulfuric acid. Rain, sleet, snow, fog, and even dry particles carry these two acids to trees and lakes.

Acid rain is sometimes strong enough to damage the surfaces of buildings and statues. It also harms lakes and ponds. Acid rain can make water so acidic that plants, amphibians, fish, and insects can no longer survive in it.

Reading Checkpoint **What is the main pollutant in photochemical smog?**

Improving Air Quality

In the United States, the federal and state governments have passed a number of laws and regulations to reduce air pollution. The Environmental Protection Agency (EPA) monitors air pollutants in the United States. Air quality in this country has generally improved over the past 30 years. The amounts of most major air pollutants have decreased. Many newer cars cause less pollution than older models. Recently built power plants are less polluting than power plants that have been in operation for many years.

However, there are now more cars on the road and more power plants burning fossil fuels than in the past. Unfortunately, the air in many American cities is still polluted. Voluntary measures, such as greater use of public transportation in place of driving, could reduce the total amount of air pollution produced. Many people think that stricter regulations are needed to control air pollution. Others argue that reducing air pollution can be very expensive and that the benefits of stricter regulations may not be worth the costs.

Reading Checkpoint **Explain one way that air quality could be improved.**

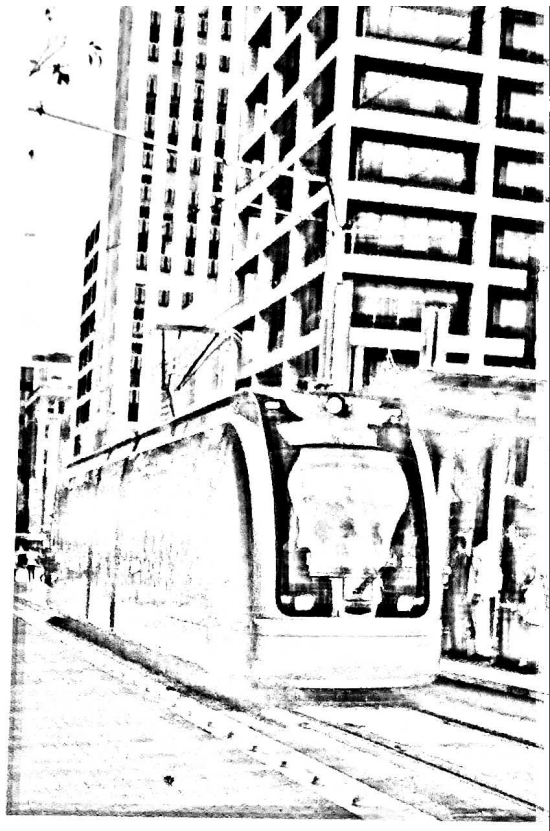

FIGURE 14
Public Transportation
Public transportation, like the light rail system above, can reduce air pollution.

Section 4 Assessment

Target Reading Skill

Outlining Use the information in your outline about air quality to help you answer the questions below.

Reviewing Key Concepts

1. a. **Defining** What is a pollutant?
   b. **Identifying** Name three natural processes and three human activities that cause air pollution.
   c. **Summarizing** What is the major source of air pollution today?
2. a. **Identifying** What human activity is responsible for the formation of smog and acid rain?
   b. **Explaining** What kinds of harm does photochemical smog cause?
   c. **Inferring** Do you think that photochemical smog levels are higher during the winter or during the summer? Explain.
3. a. **Identifying** What government agency monitors air quality?
   b. **Summarizing** How and why has the air quality changed in the United States over the last 30 years?

Lab zone At-Home Activity

Dust in the Air It's easy to see particles in the air. Gather your family members in a dark room. Open a window shade or blind slightly, or turn on a flashlight. Can they see tiny particles suspended in the beam of light? Discuss where the particles came from. What might be some natural sources? What might be some human sources?